

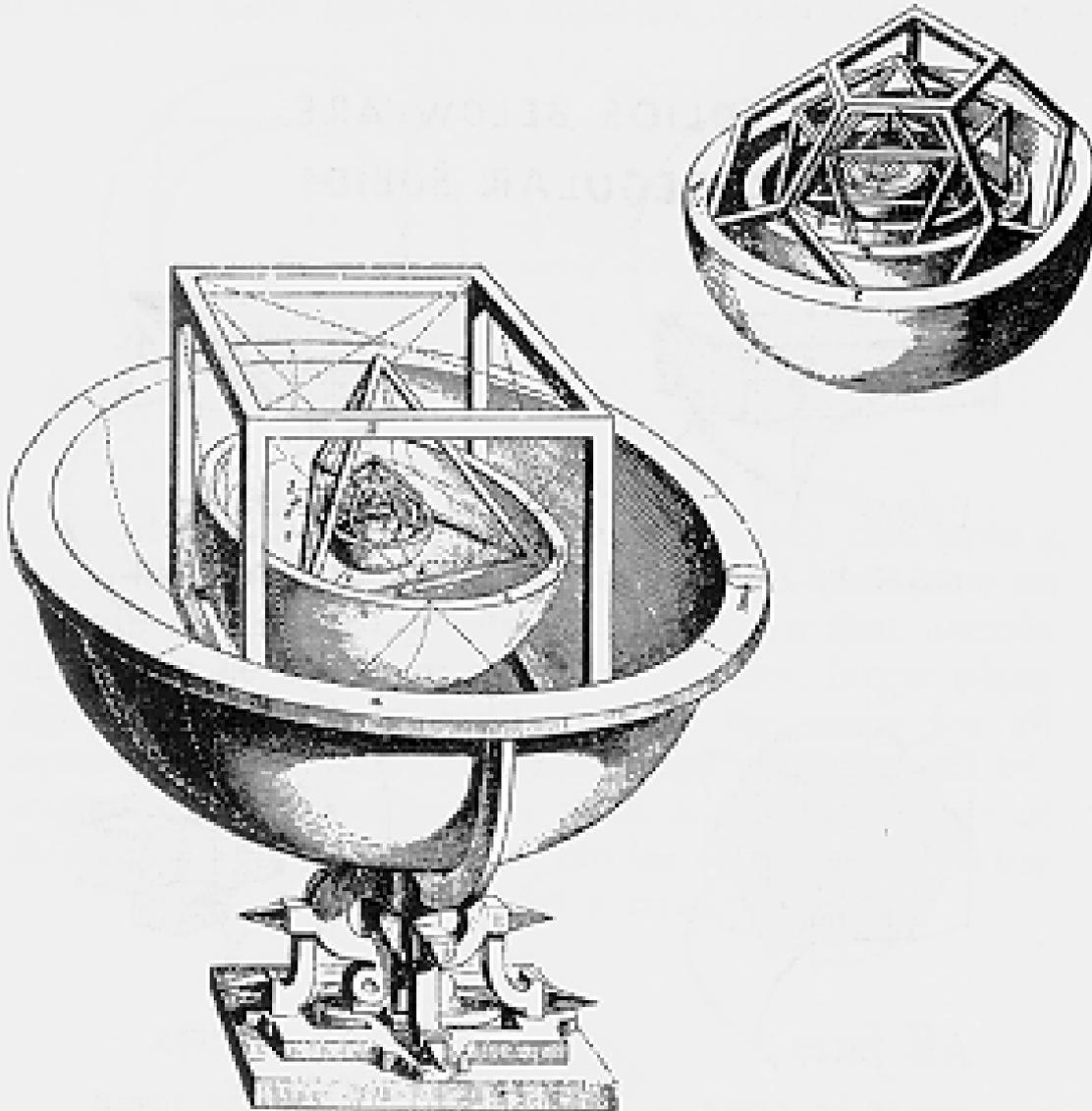
NS 102

Lecture 4

April 7, 2005

Opening:
Universally speaking
Red Hot Chili Peppers

Closing:
Satellite
Dave Matthews Band



GnatSigh News

(all the news that fits)

- On late homework
- Lab assignments

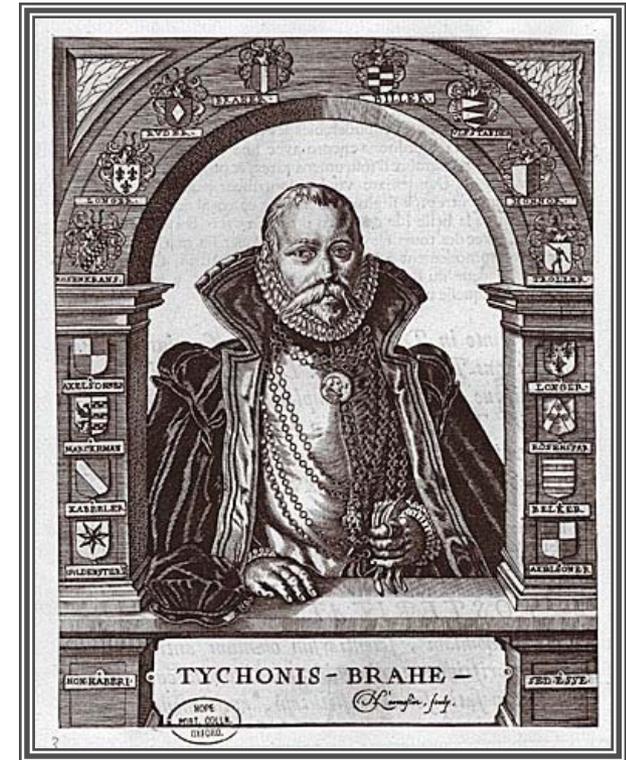
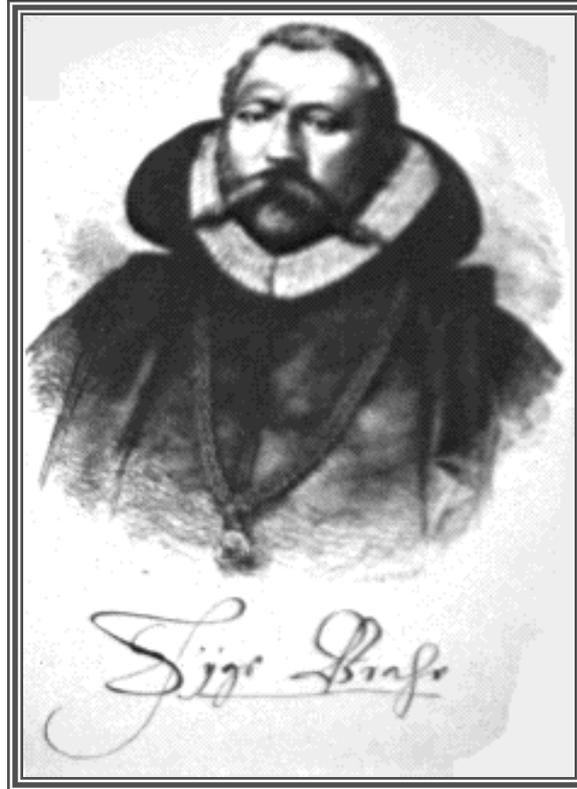
Mr. Kurt Henriksen (kurt@oddjjob.uchicago.edu)
check website & posted list

- <http://home.fnal.gov/~rocky/NS102/>
- Hugo Z. Hackenbush, Rufus T. Firefly, Otis P. Driftwood, Wolf J. Flywheel, S. Quentin Quail, & Jeffrey T. Spaulding have been dismissed as TAs.
New TAs are listed on the website (class information).



Tycho Brahe Tyge Brage

1546 - 1599



Cassiopeia



George Busch (German painter) in 1572:

“It is a sign that we will be visited by all sorts of calamities such as inclement weather, pestilence, and Frenchmen.”

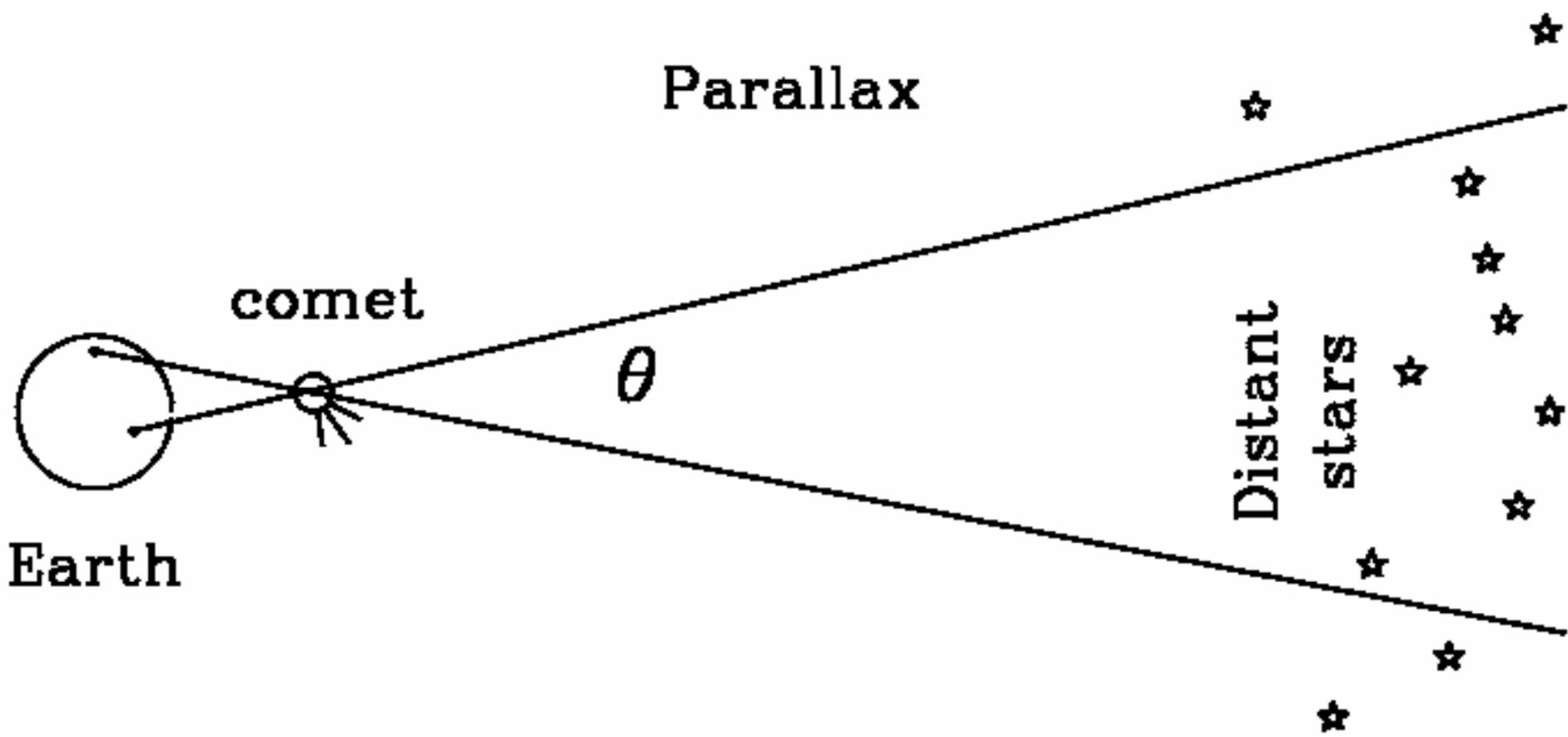
Monastic Chronicles re: Supernova 1006:

“in 1006 there was a very great famine and a comet appeared for a long time”

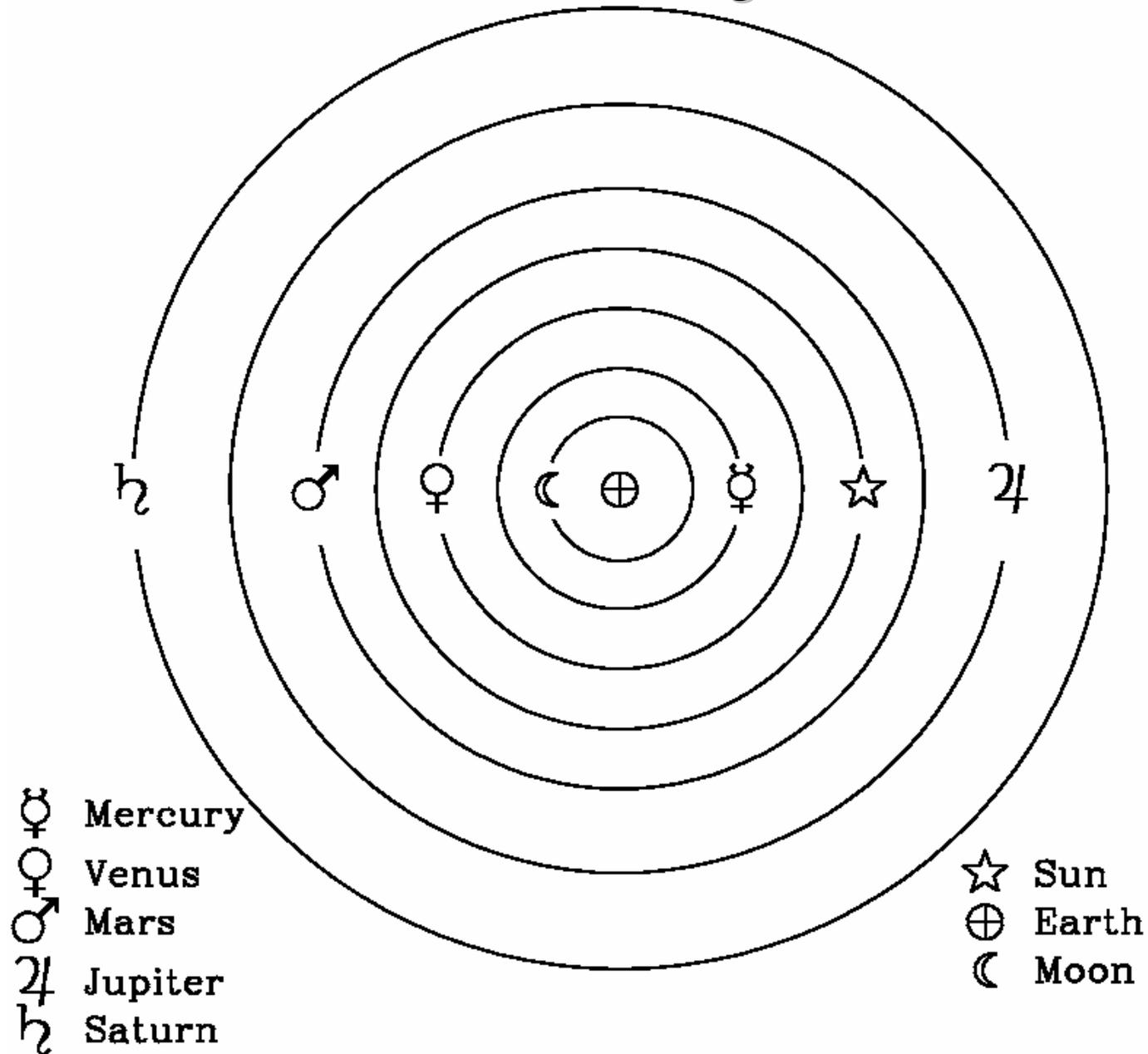
“at the same time a comet, which always announces human shame, appeared in the southern regions, which was followed by a great pestilence...”

“three years after the king was raised to the throne, a comet with a horrible appearance was seen in the southern part of the sky, emitting flames this way and that...”





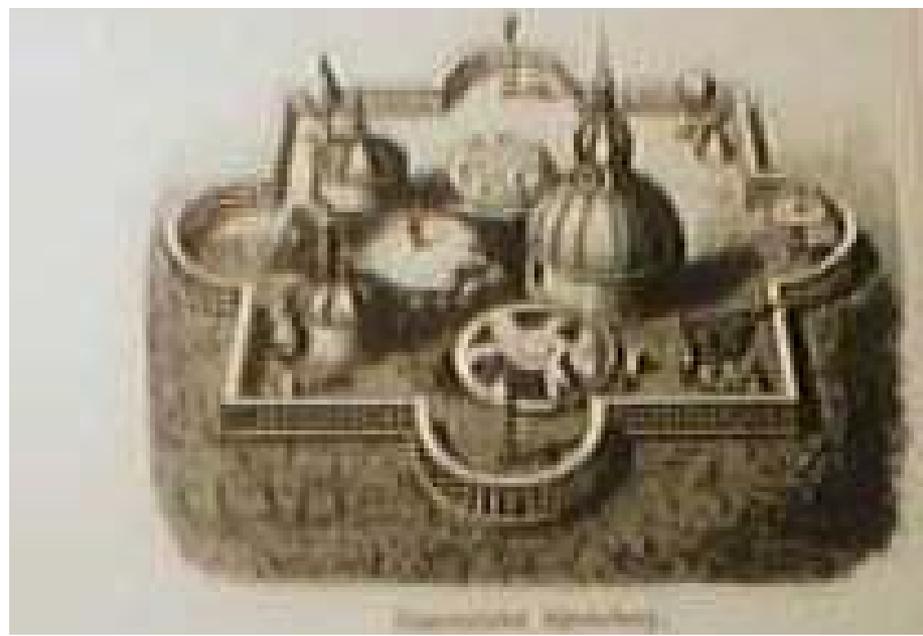
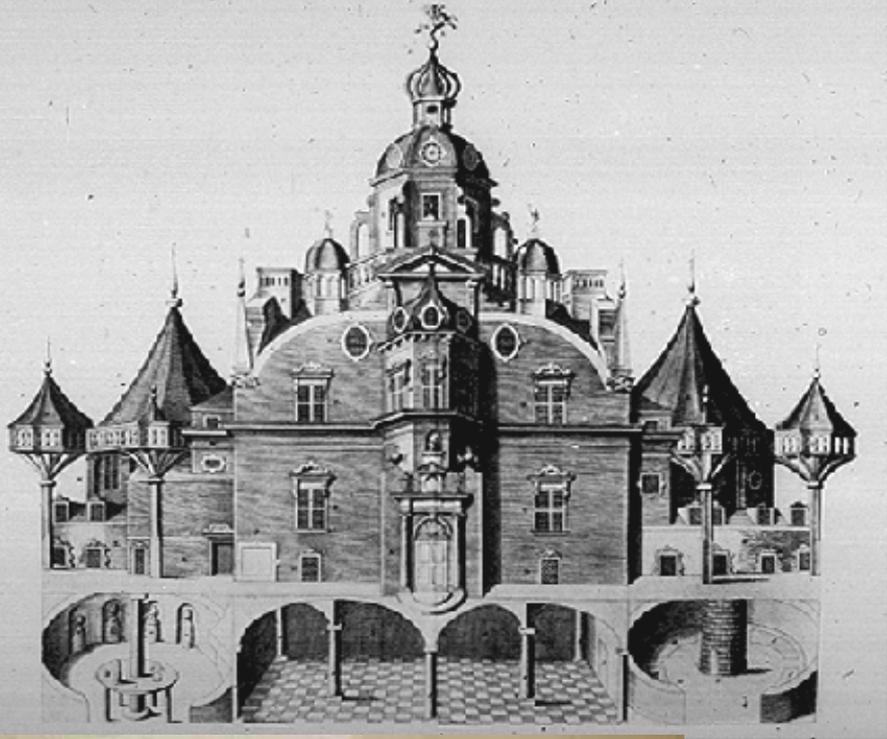
The Universe According to Aristotle



O crassa ingenia. O cæcos cœli spectatores.

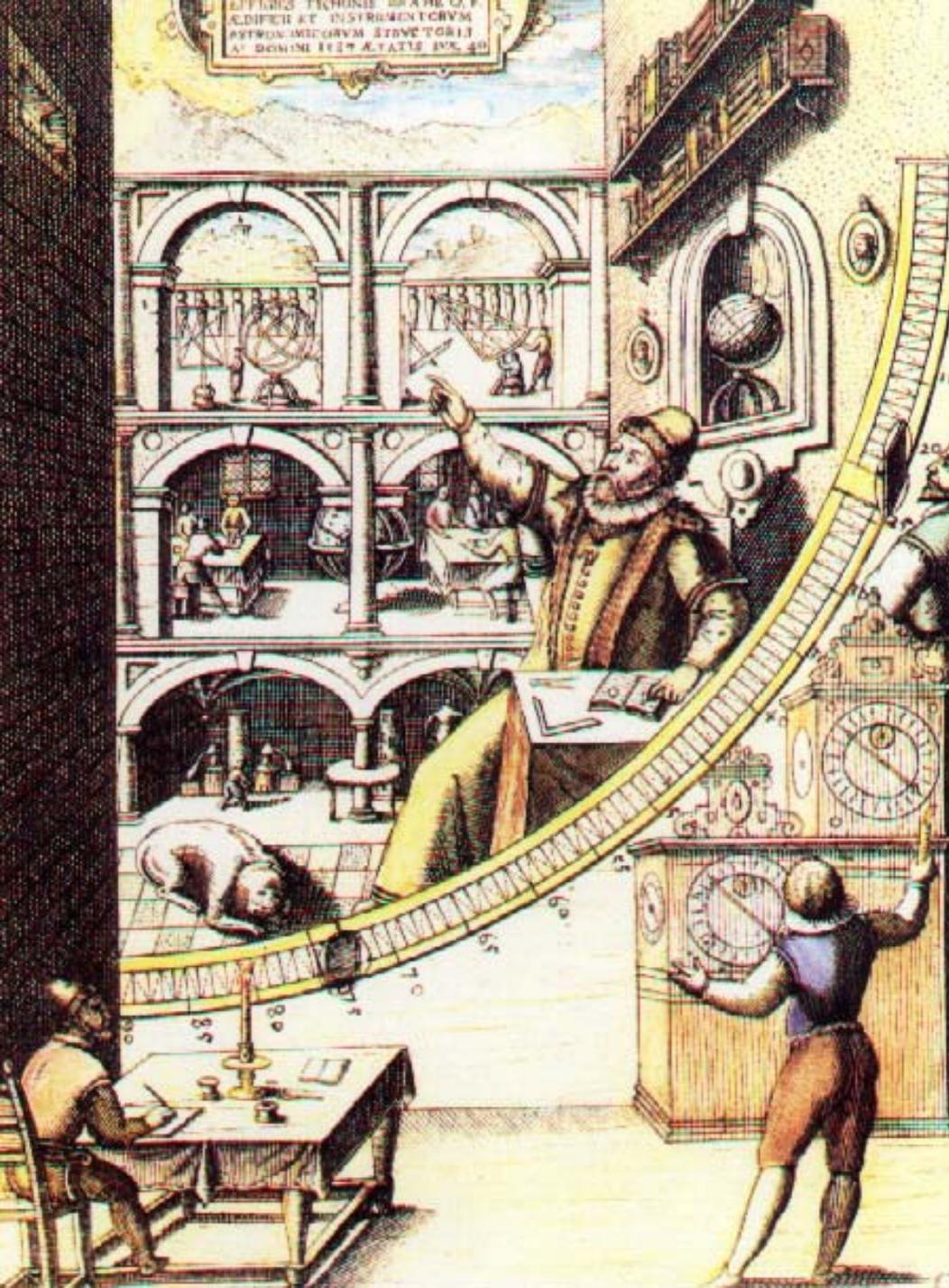
Oh thick wits. Oh Blind Watchers of the Sky.

-- Tycho Brahe 1573

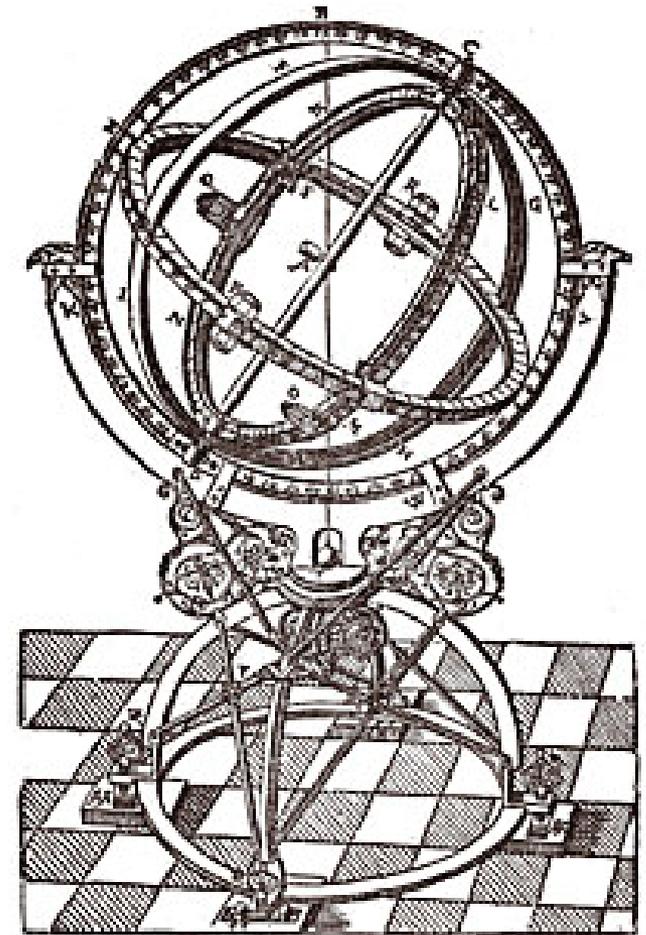


Uraniborg





ARMILLÆ ALIÆ ÆQVATORIÆ.

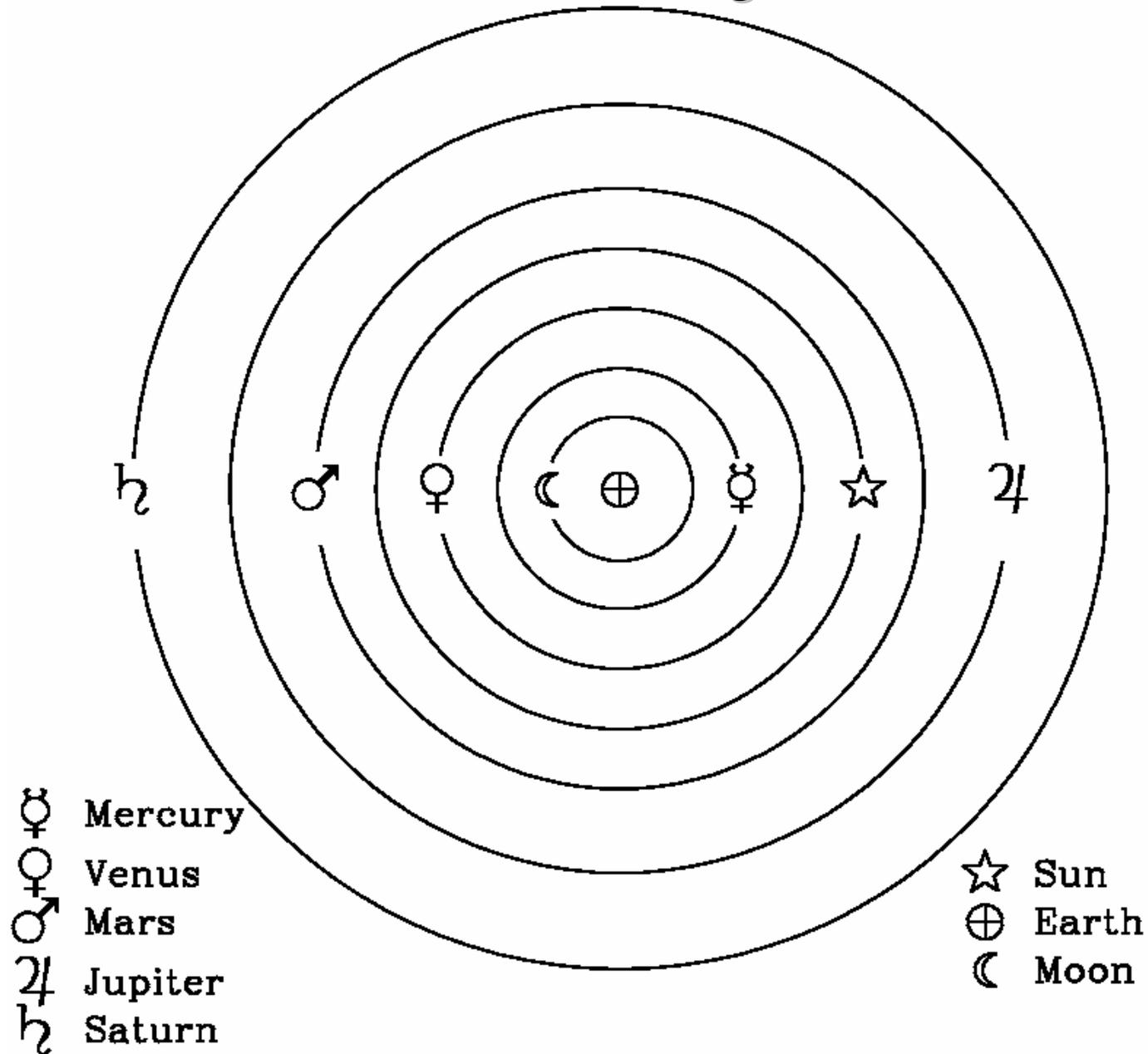




Tycho with the King

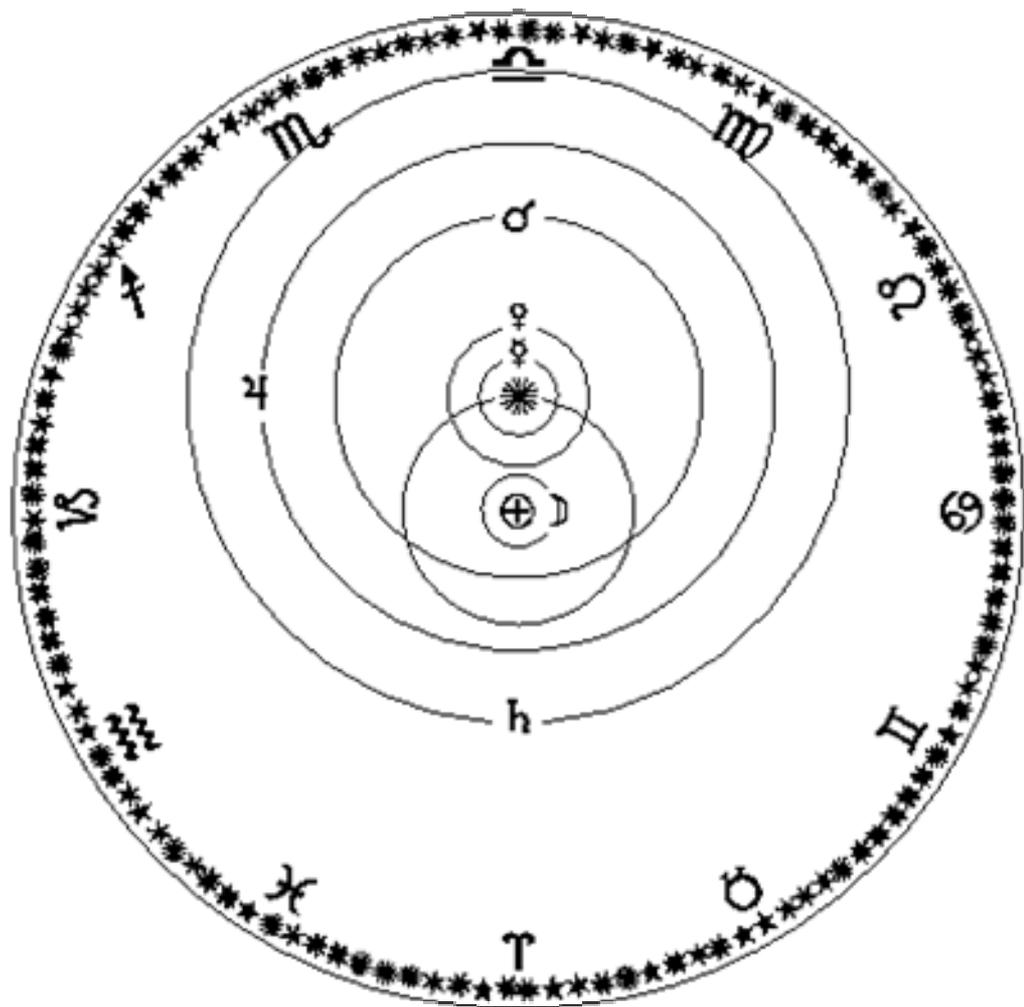


The Universe According to Aristotle

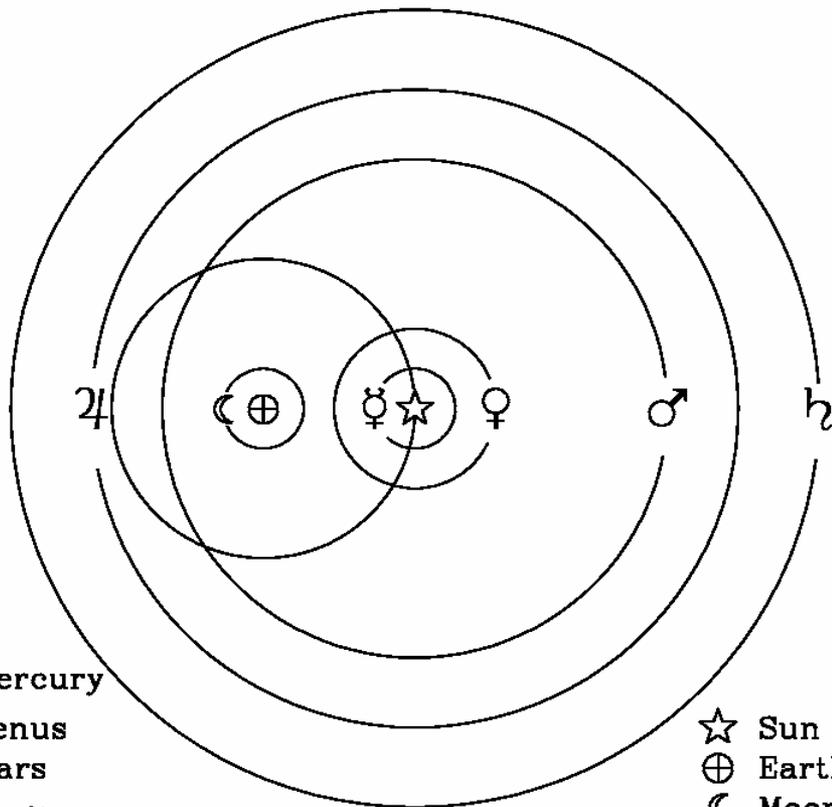


NOVA MVNDANI SYSTEMATIS HYPOTYPOSIS AB
 AUTHORE NUPER ADINVENTA, QUA TUM VETUS ILLA
 PTOLEMAICA REDUNDANTIA & INCONCINNITAS,
 TUM ETIAM RECENS COPERNIANA IN MOTU
 TERRÆ PHYSICA ABSURDITAS, EXCLU-
 DUNTUR, OMNIAQUE APPAREN-
 TIIS CÆLESTIBUS APTISSIME
 CORRESPONDENT.

“avoiding both the
 mathematical absurdity
 of Ptolemy and the
 physical absurdity of
 Copernicus”

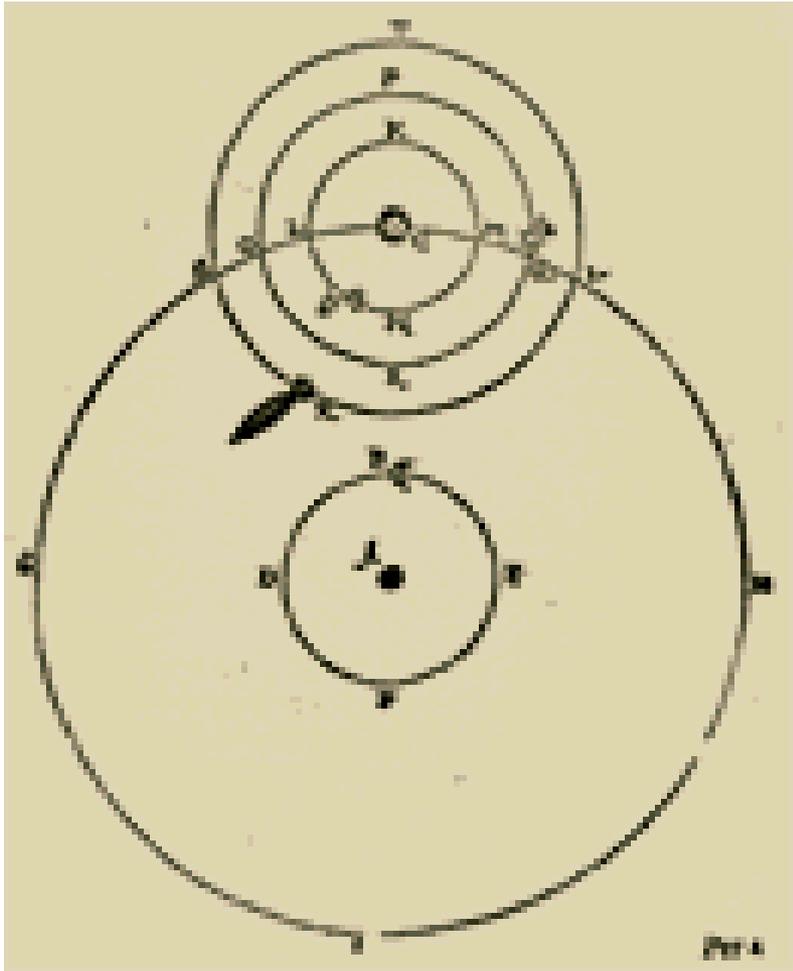


The Tychonic Arrangement



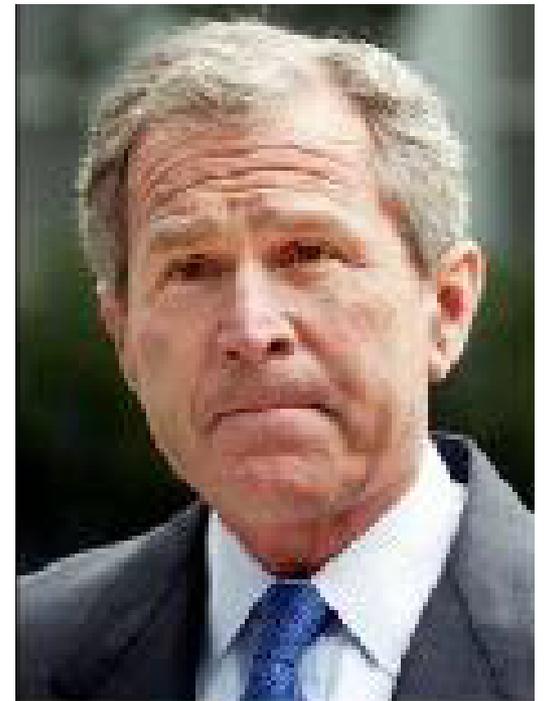
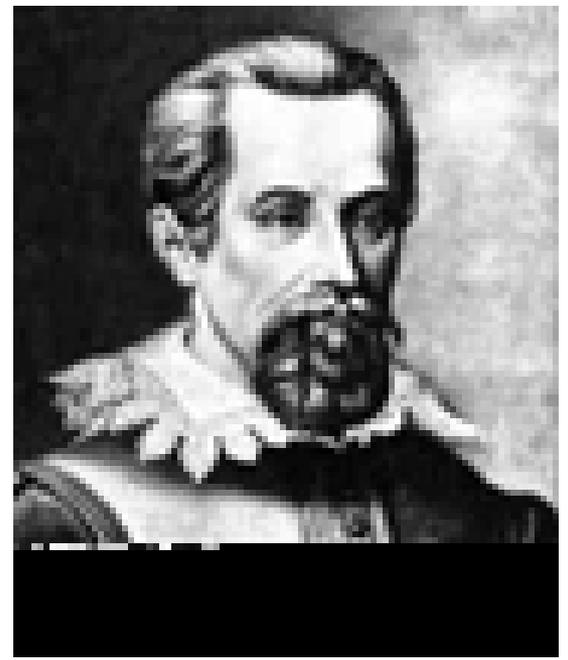
- ☿ Mercury
- ♀ Venus
- ♂ Mars
- ♃ Jupiter
- ♄ Saturn

- ☆ Sun
- ⊕ Earth
- ☾ Moon



ANNO DOMINI MDCI DIE XXV OCTO
BRIS OBIIT ILLVSTRIS & GENEROSVS DVVS TYCHO BRAHE DVVS ANK
SACRAE CAESARIS MAIESTATIS CONSILIARIVS CIVIS OSSA HIC REQVIESCIT
S. M. P. C. P. R. S. S. I. R. A. M. S. A. G. O. C. C.





Johannes Kepler:

Kepler, Keppler, Khepler, Kheppler, and Keplerus

Michelangelo Merisi:

Merisi, Amerigi, Merigi, Merici, Morisi, Merisio, Morigi,
Morisimus, Amarigi, Marigi, Marisi, Narigi, Moriggia,
Marresi, and Amerighi

Parking Available For:

- NBC Tower
- 401 N. Michigan
- Sheraton Hotel
- Univ. of Chicago
- Navy Pier
- North Pier Terminal
- Jerry Springer



...at the age of 4, I nearly died of smallpox.

... my hands were badly crippled.

... during the age of 14 & 15 I suffered continuously from skin ailments, severe sores, scabs, putrid wounds on my feet.

... on the middle finger of my right hand I had a worm.

... I had a huge sore on my left hand.

... when 16 I nearly died of a fever.

... at 19 I suffered from headaches and disturbances of my limbs.

... I continuously suffered from the mange and the dry disease.

... at the age of 20 I suffered a disturbance of the body and mind.

...once, at the urging of my wife, I took a bath.

... it's heat constricted my bowles and nearly killed me.

... I believe I am one of those people whose gall bladder has a direct opening into the stomach. Such people are short-lived as a rule.

...I hated Kolinus.

... Braunbaum was my enemy.

... I willingly incurred the hatred of Seiffer.

... Ortholphus hated me as I hated Kolinus.

... Kleberus hated me as a rival.

... my talent made Rebstock hate me.

... Husalius opposed my progress.

... Jaeger betrayed me.

... at the age of 21 I gained knowledge of woman. I achieved this with the greatest possible difficulty, experiencing the most acute pains of the bladder.

Barbara Muehleck Kepler:

“... simple of mind and fat of body, with a stupid, sulking, lonely, melancholy disposition.”

...that man has in every way a dog-like nature.

... his appearance is that of a little lapdog.

... his appetites are like a dog; he likes gnawing on bones and dry crusts of bread.

... like a dog he drinks little and is content with the simplest foods.

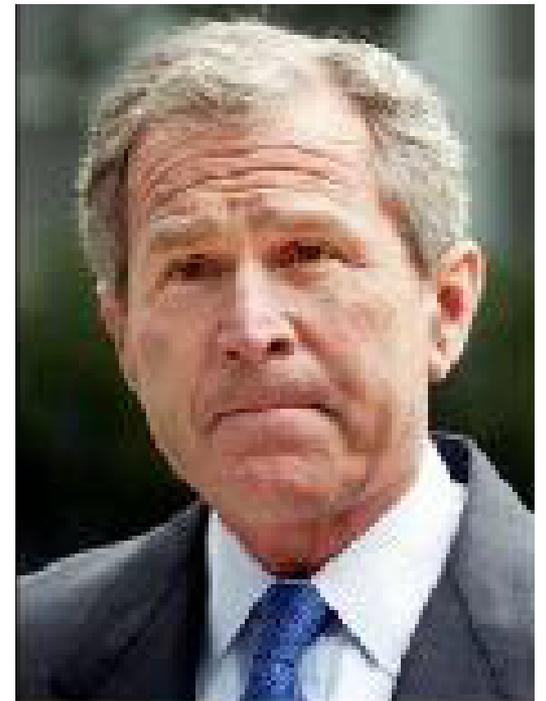
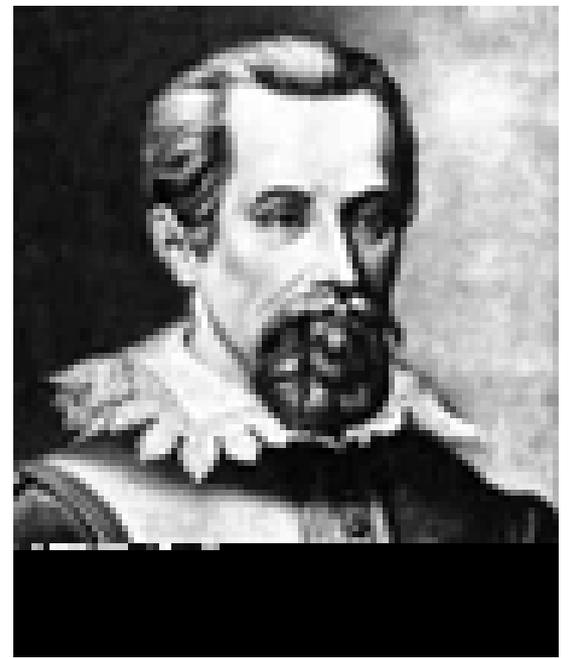
... he happily greets visitors like a dog.

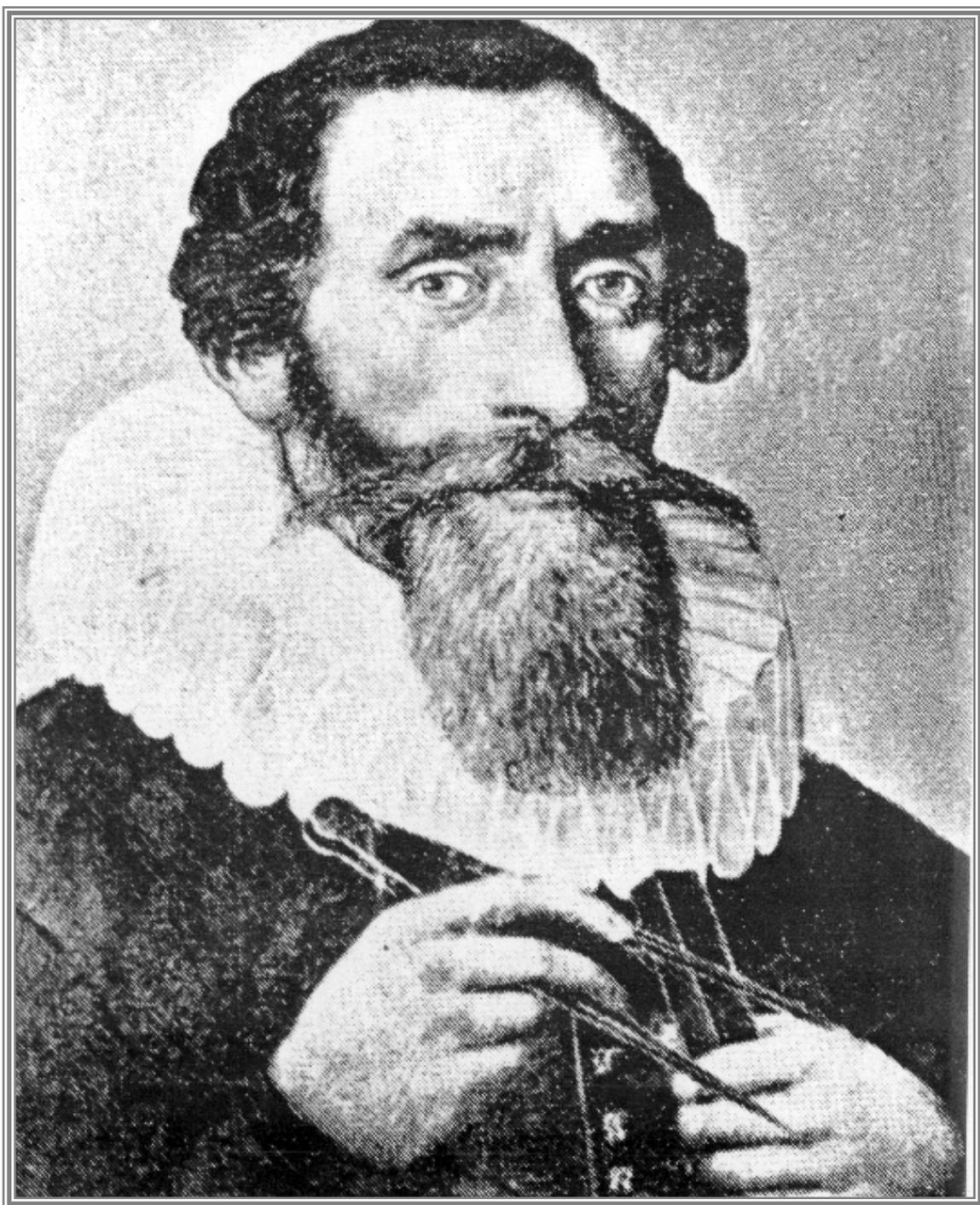
... when something is snatched from him he sits up and growls.

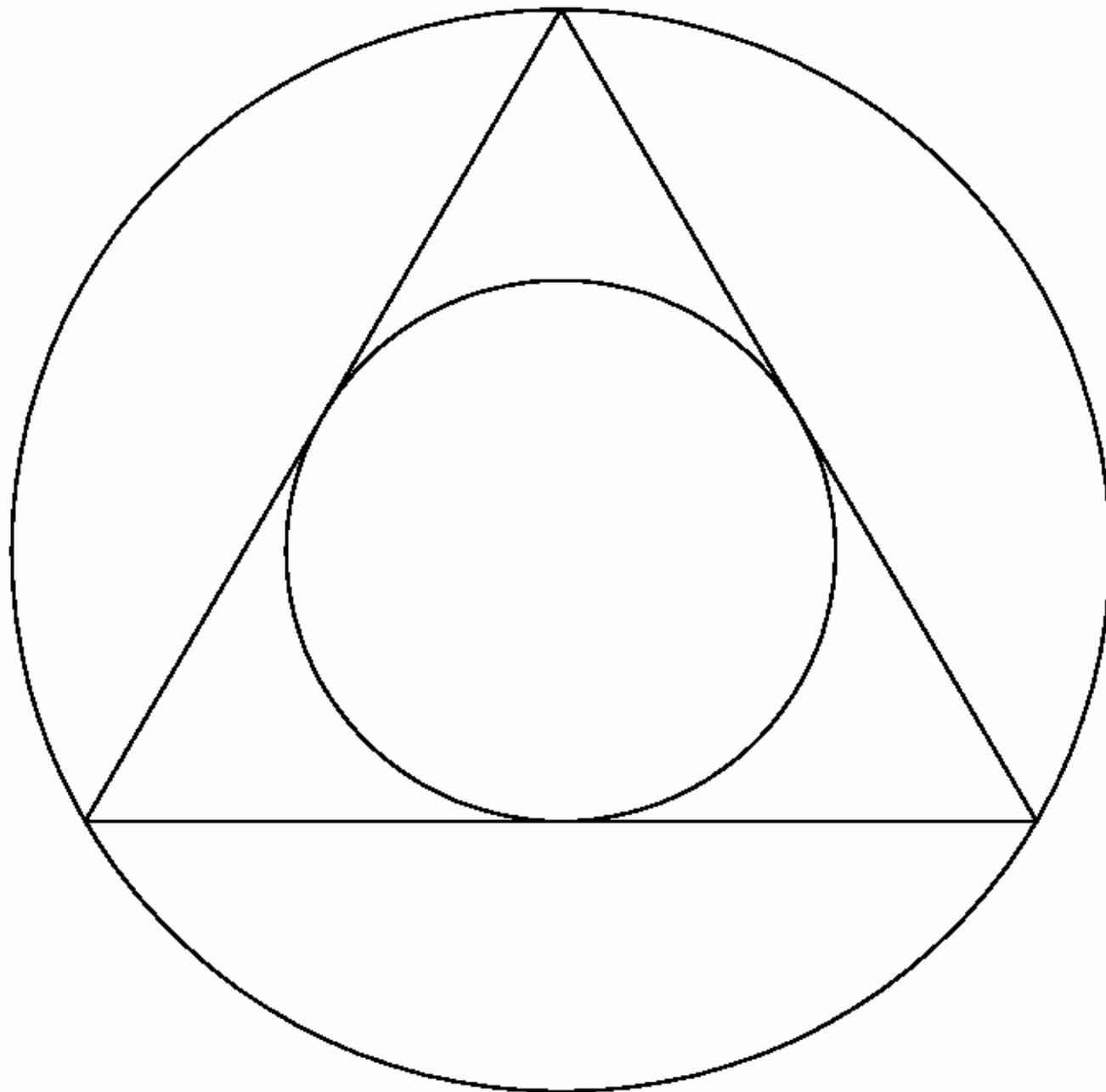
... he barks at wrong doers

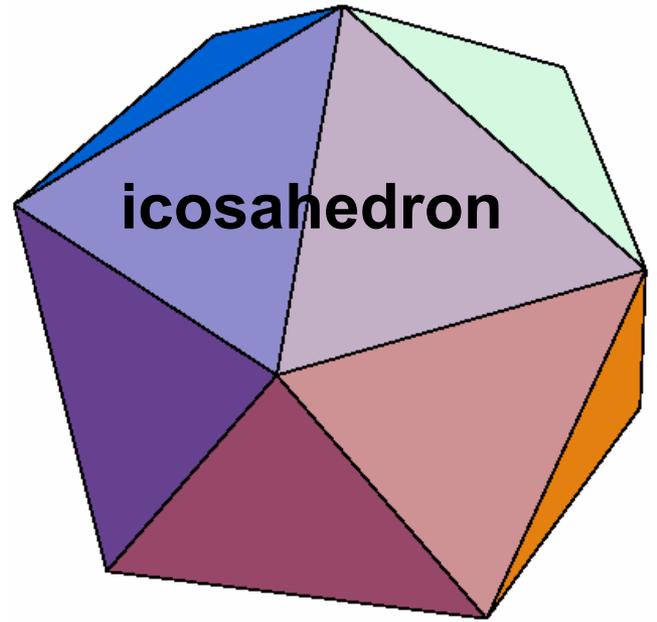
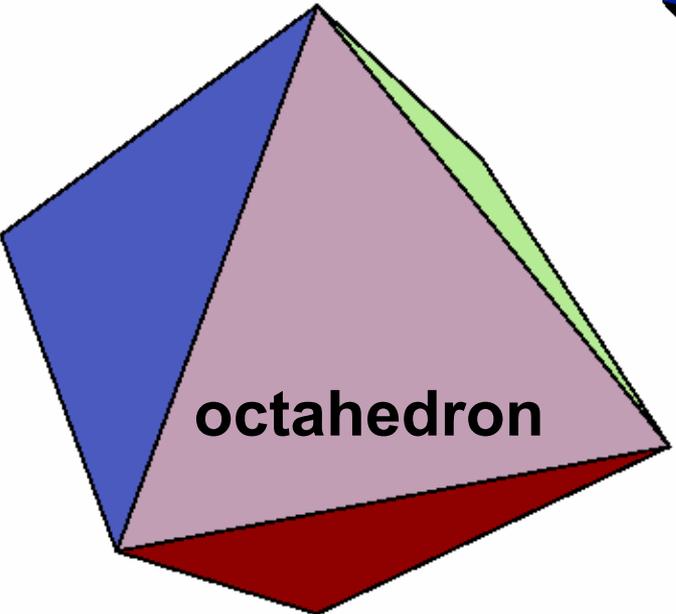
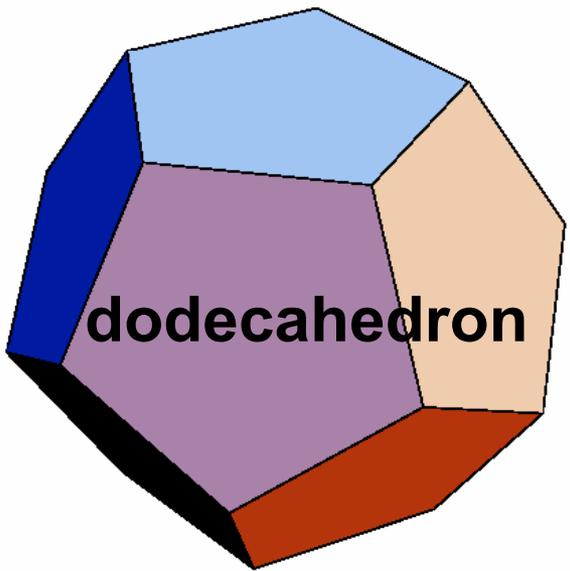
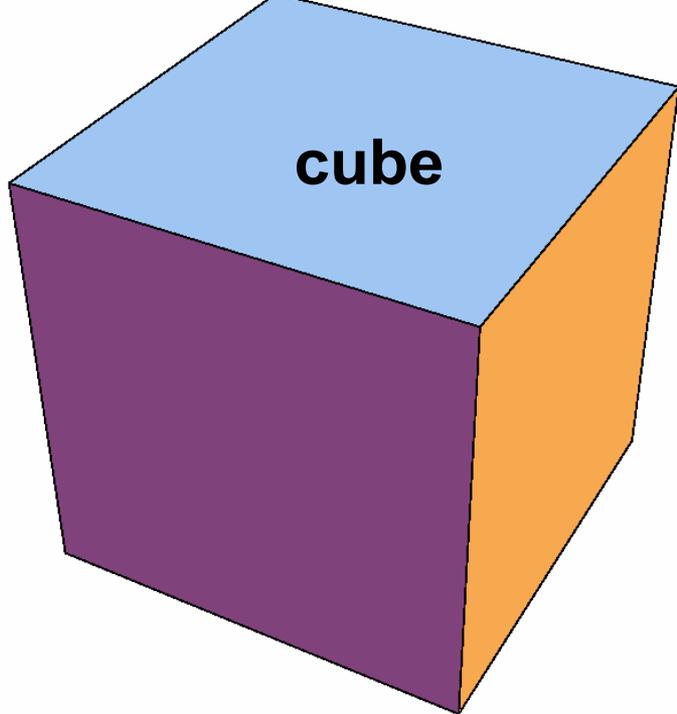
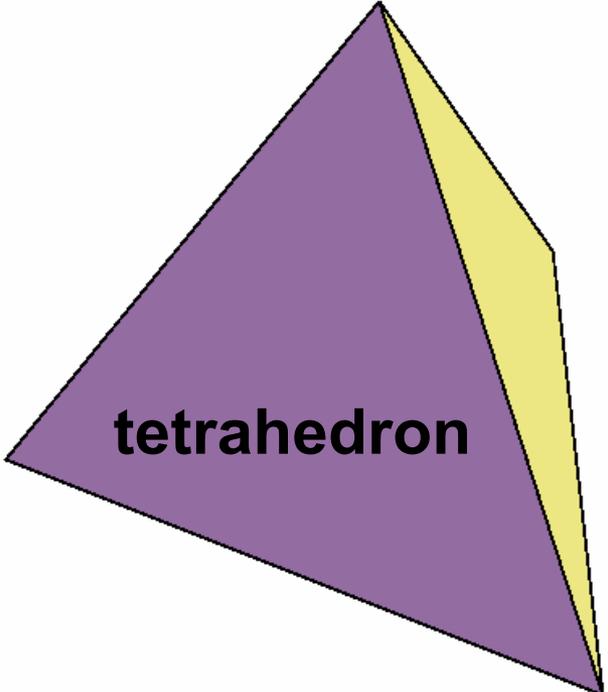
... he is malicious and bites people with sarcasms.

... he has a dog-like horrors of baths

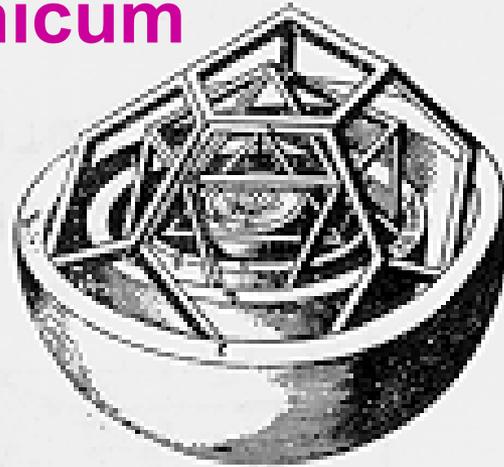
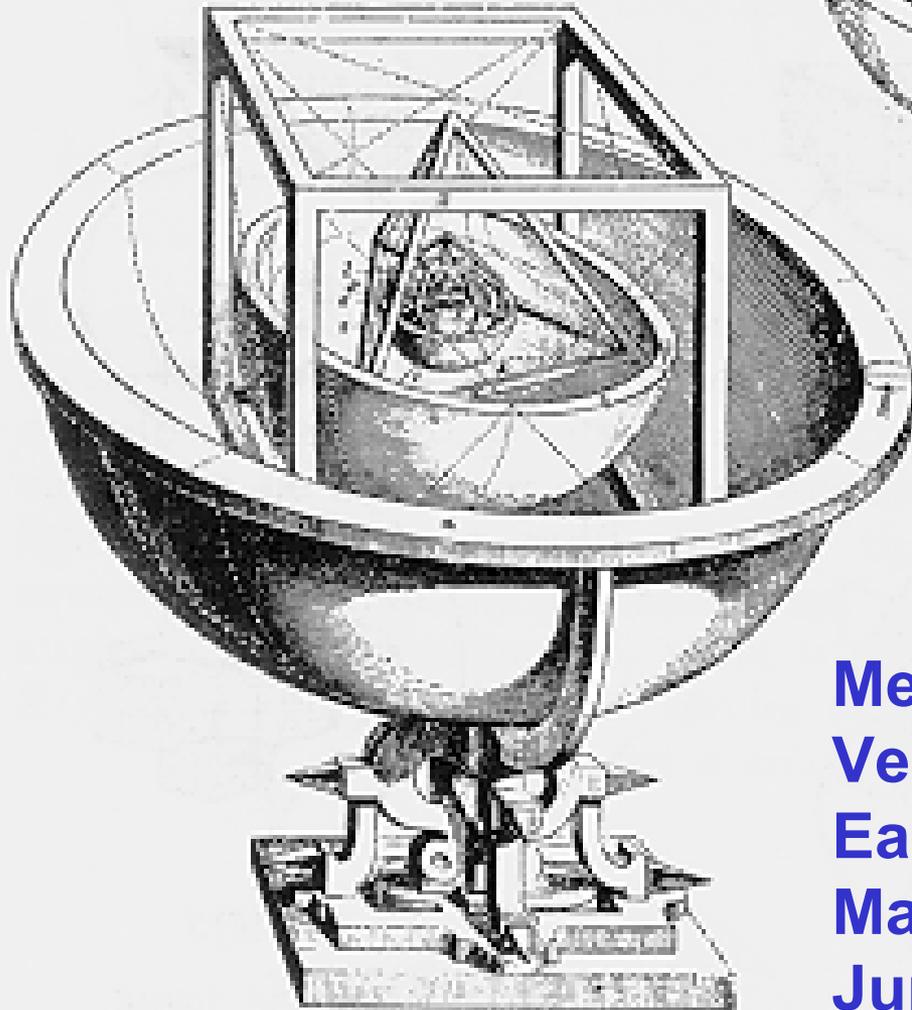








Mysterium Cosmographicum



Mercury – octahedron - Venus
Venus – icosahedron – Earth
Earth – dodecahedron – Mars
Mars – tetrahedron – Jupiter
Jupiter – cube - Saturn

Planets and Polyhedra	from Polyhedra	from Copernicus
Saturn-cube-Jupiter	577	635
Jupiter-tetra-Mars	333	333
Mars-dodeca-Earth	795	795
Earth-icosa-Venus	795	794
Venus-octa-Mercury	707	723

Nicolai Copernici, *Revolutions*
Book One

(Edward Rosen translation)

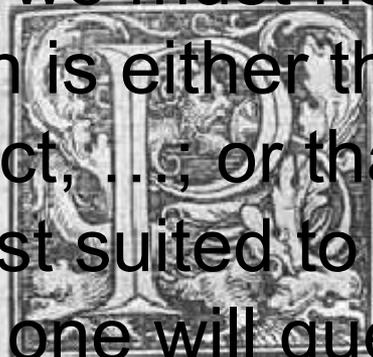
The Universe is Spherical, Chapter 1

Quod mundus sit sphaericus. Cap. I.

First of all, we must note that the universe is spherical.

The reason is either that, of all forms, the sphere is the most perfect, ...; or that it is the most capacious* of figures, best suited to enclose and retain all things; ...

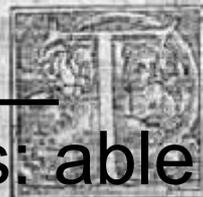
Hence, no one will question the attribution of this form to the divine bodies.



INCIPPIO aduertendum nobis est, glo-
riam. ...
ma perfectissima sit omnium, nulla indi-
gens compage, ita ut ne grauiora
insa, et parissima sit figurarum, quae com-
prehendatur omnia, & conseruatur inani-
tatem: ...
quaeque mundi partes, Solem dico, Lunam & stellas, tali forma
complectatur: siue quod hac uniuersa appetat terminari, quod
in aquae guttis caeterisque liquidis corporibus apparet, dum per
se terminari cupiunt. Quo minus talem formam coelestibus cor-
pibus attributam quisquam dubitauerit.

The Earth Too is Spherical. Chapter 2

Quod terra quoque sphaerica sit. Cap. II.



Erram quoque globosam esse, quoniam ab omni parte centro suo innititur. Tamen si absolutus orbis non statim uideatur, in tanta montium excelsitate, descen-

*capacious: able to contain much.

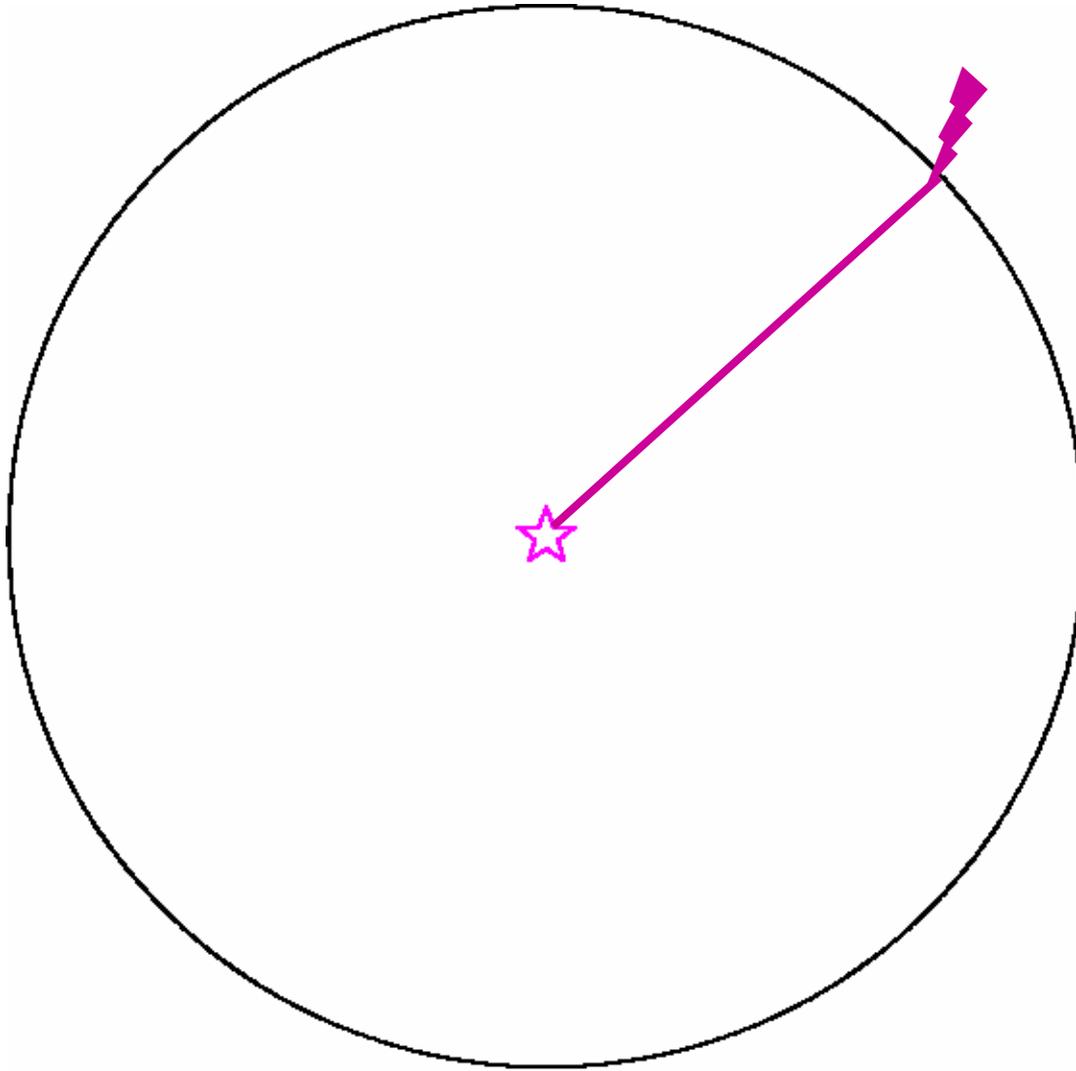
Kepler's 1st Law



circle

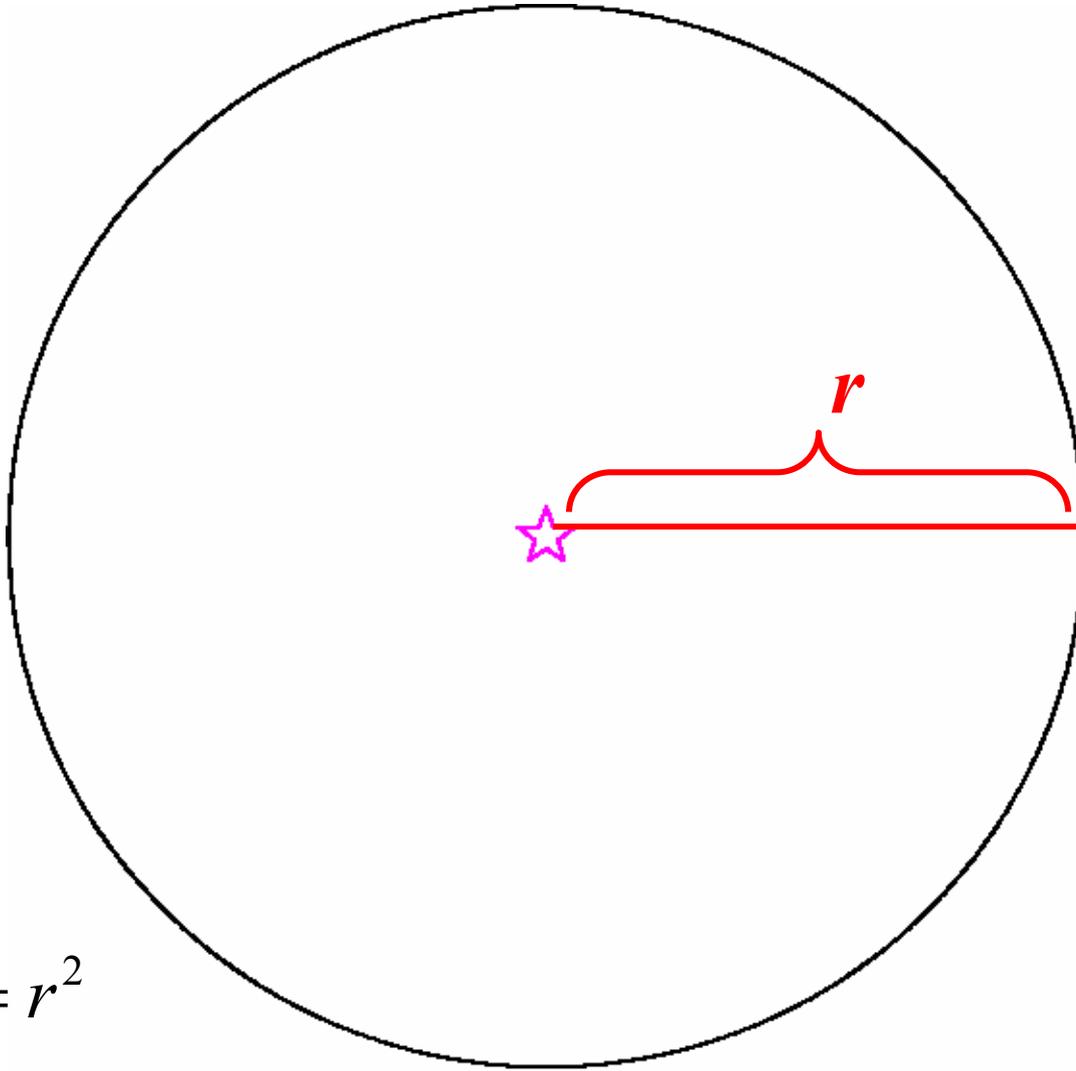


center



circle

☆
center



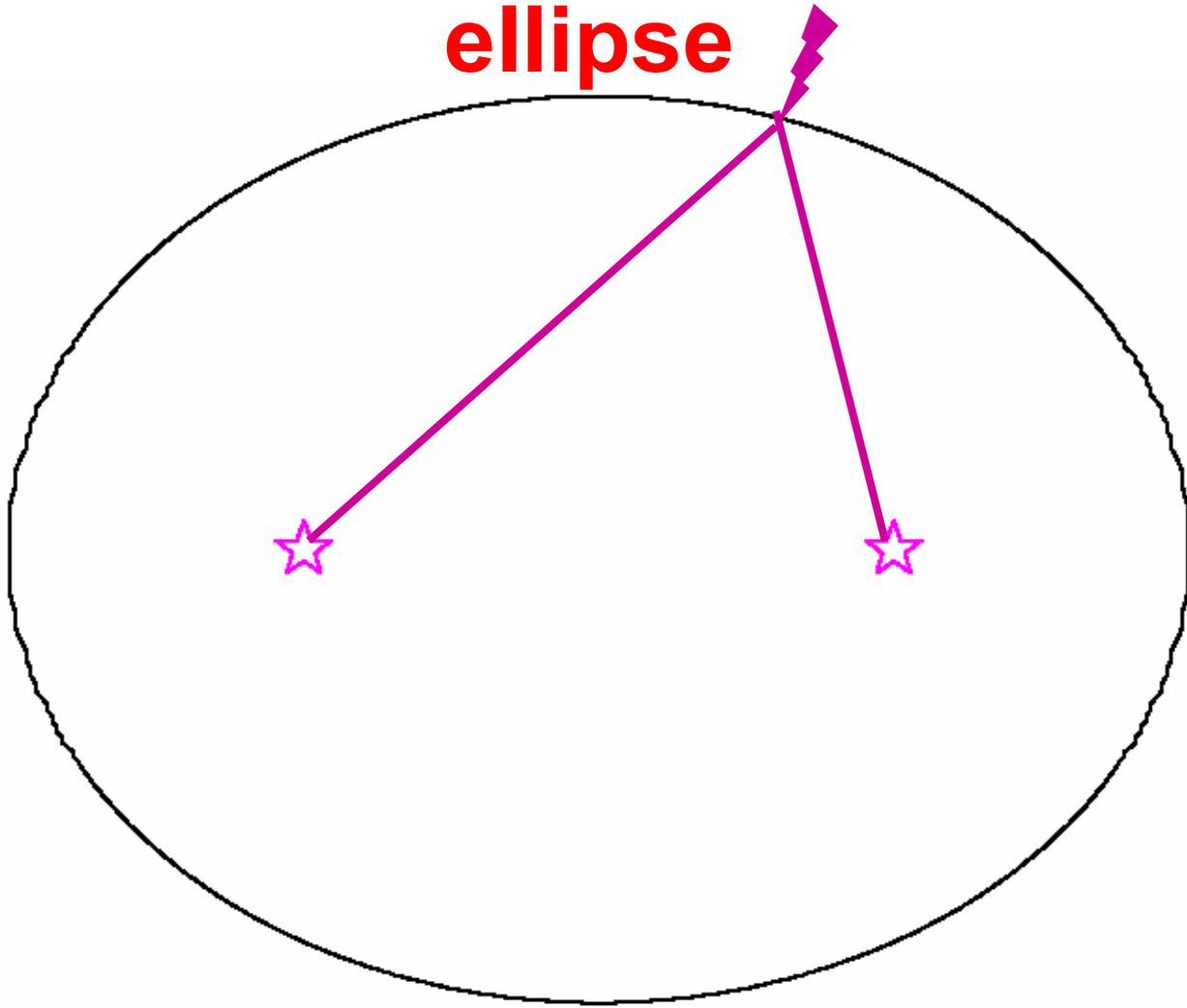
$$x^2 + y^2 = r^2$$

$$\frac{x^2}{r^2} + \frac{y^2}{r^2} = 1 \quad r^2 > 0$$

ellipse

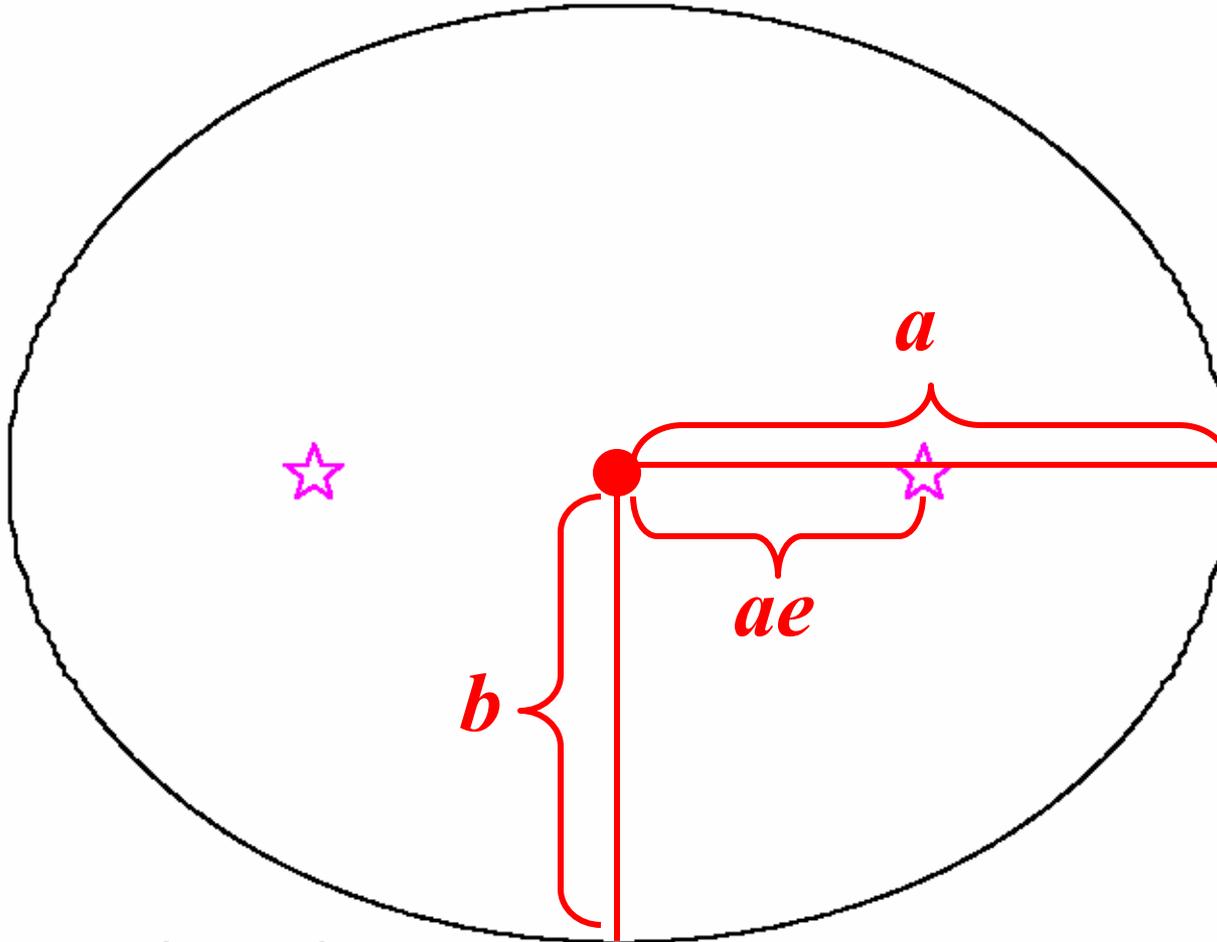


focus



ellipse

☆
focus

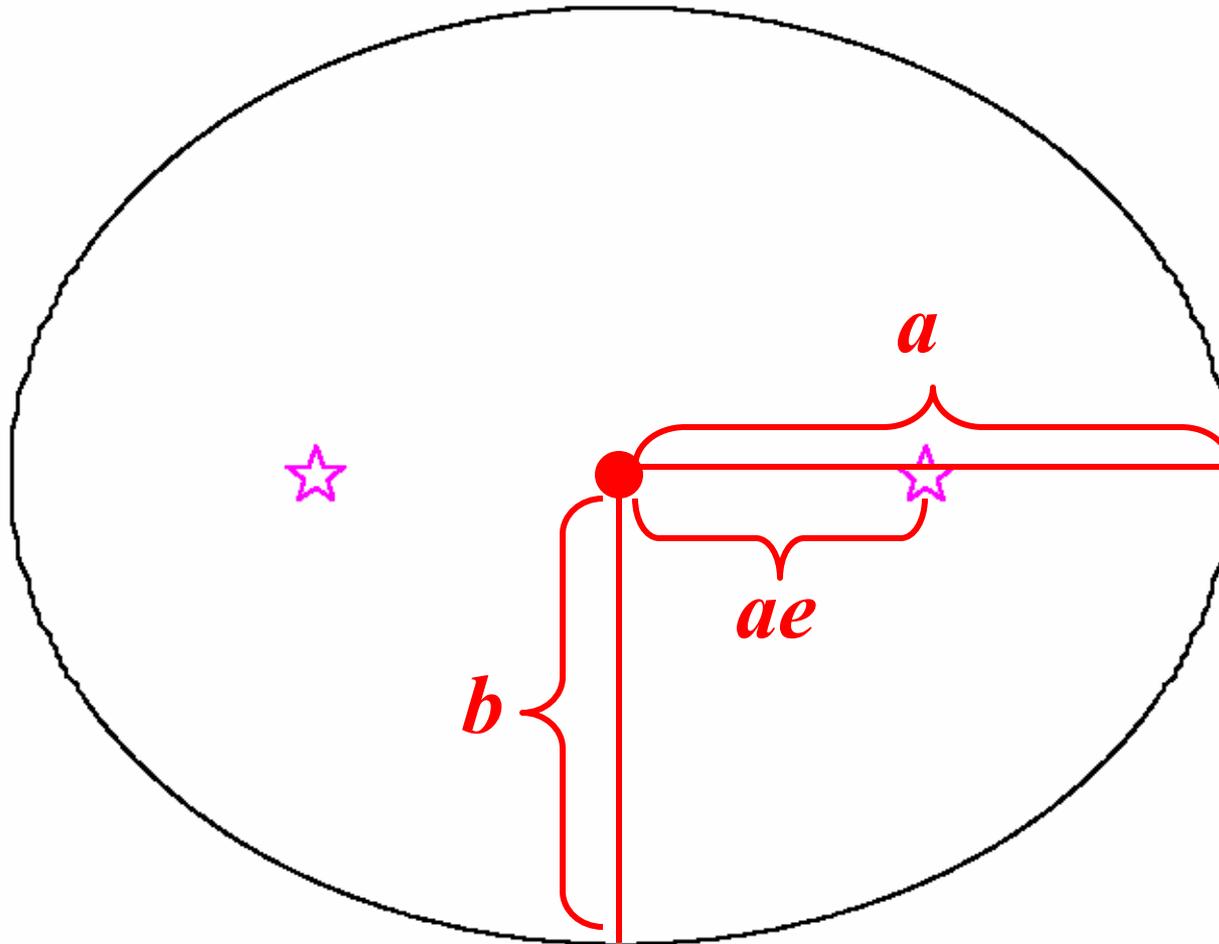


$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad a > b > 0$$

$$\text{eccentricity } e = \sqrt{1 - b^2 / a^2} = 0.5$$

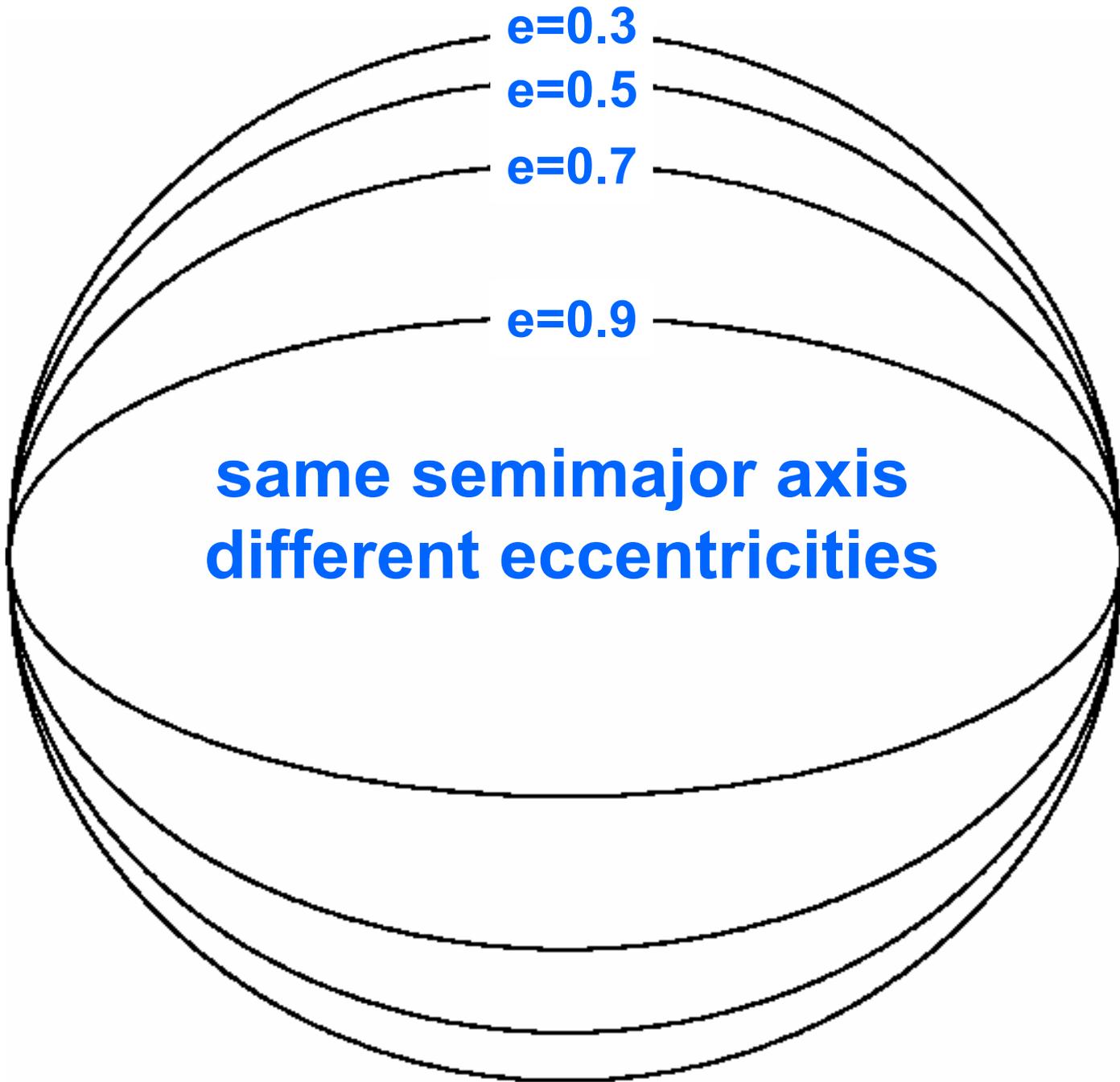
ellipse

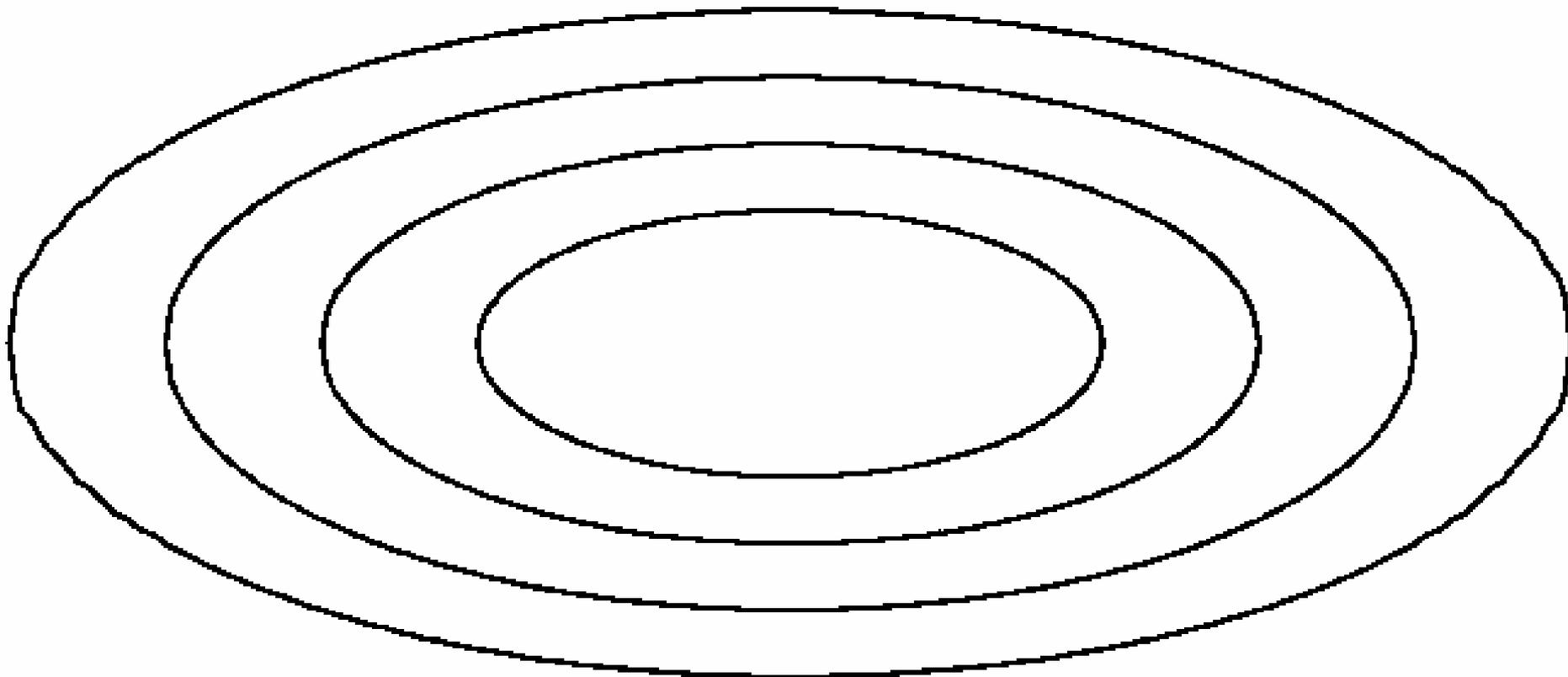
☆
focus



$$\text{eccentricity } e = \sqrt{1 - b^2/a^2} = 0.5$$

$$b/a = \sqrt{1 - e^2} \approx 1 - \frac{1}{2}e^2 \quad \text{for } e \text{ small}$$

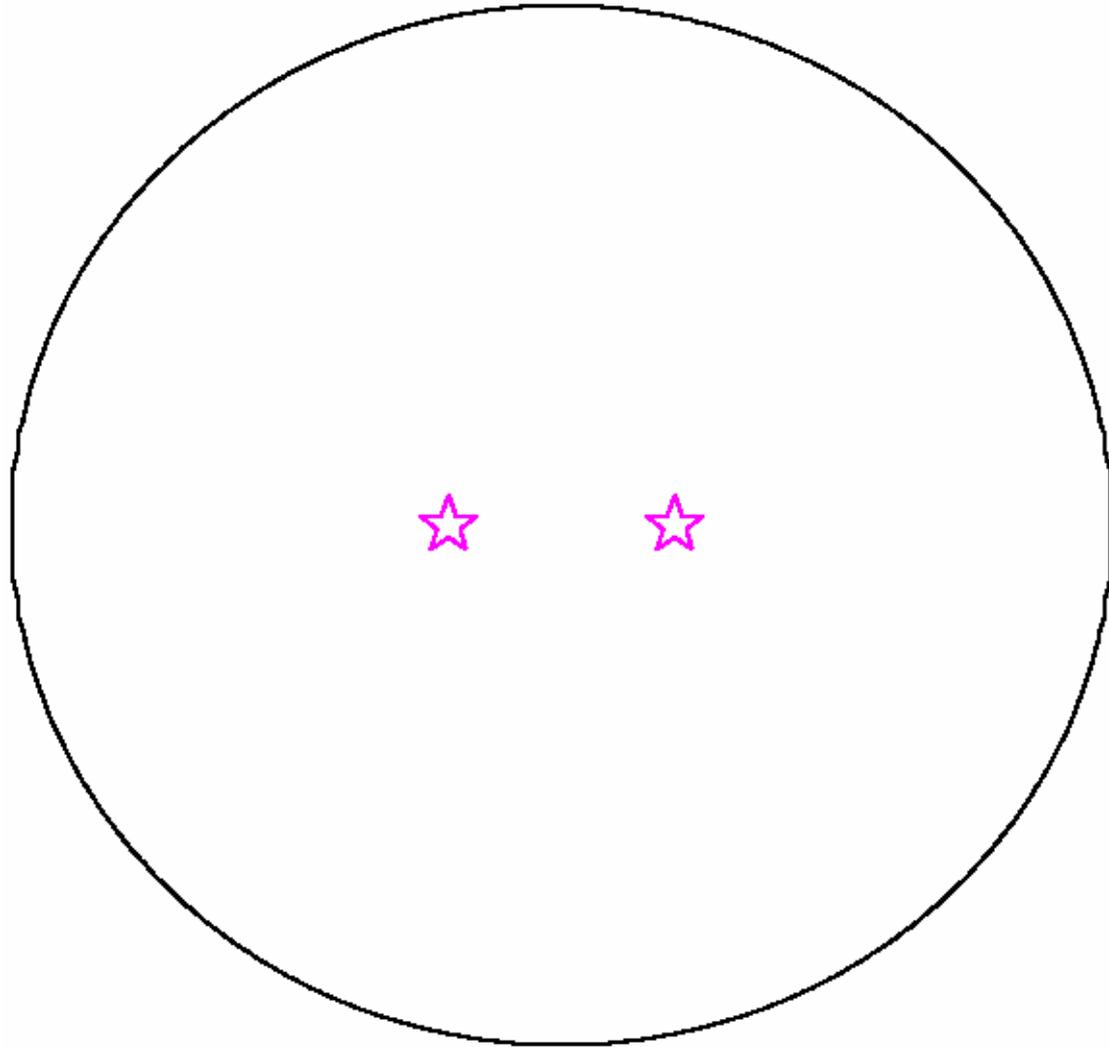




same eccentricity

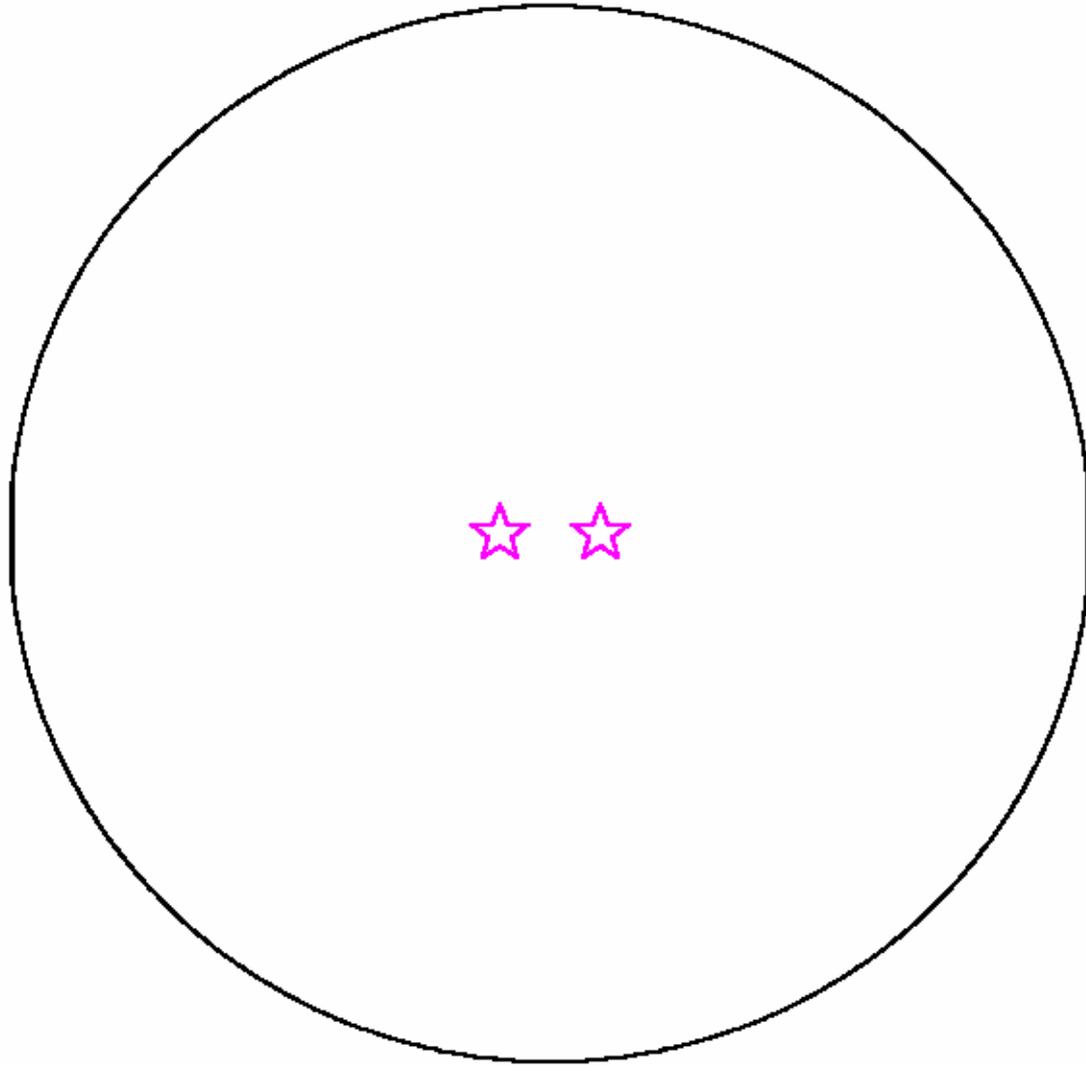
different semimajor axis

Mercury

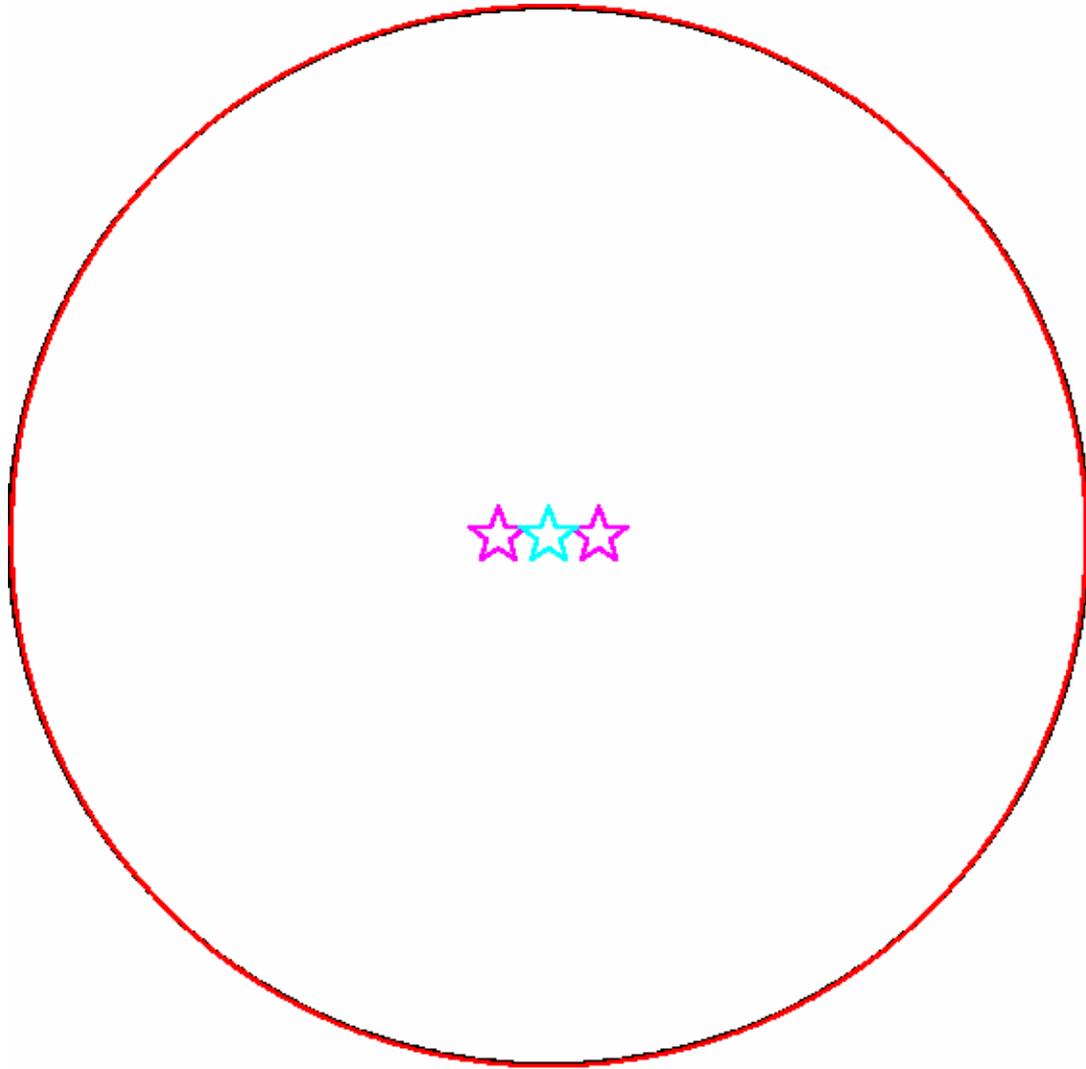


eccentricity = 0.2

Mars



eccentricity = 0.09



○ **ellipse with eccentricity of Mars** **circle with same area** ○

The Ptolemaic Epicycle

